CAMBRIDGE SYSTEMATICS

Bay Area/California High-Speed Rail Ridership and Revenue Forecasting Study

Model Design, Data Collection and Performance Measures

technical

memorandum

prepared for

Metropolitan Transportation Commission

prepared by

Cambridge Systematics, Inc.

with

Citilabs
Corey, Canapary & Galanis
HLB Decision Economics, Inc.
Mark Bradley Research & Consulting
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1.0 Introduction

A requirement in the California State Streets and Highways Code (Assembly Bill #3047, approved by the Governor on September 21, 2004) directs the Metropolitan Transportation Commission (MTC) and the California High-Speed Rail Authority (HSRA) to study Bay Area access to the high-speed rail system. To meet this requirement, a consultant team led by Cambridge Systematics was selected to develop a new statewide multimodal travel demand model.

The purpose of developing this model is to examine high-speed rail alternatives in California, in particular, high-speed rail connections from the San Joaquin Valley to the San Francisco Bay Area. The model system will be used to prepare ridership and revenue forecasts. The travel forecasts prepared for this study are intended for use in further detailed environmental analysis work to be conducted by the California High-Speed Rail Authority.

The overall project work includes a number of discrete tasks related to model development, data collection, and model application. The project also includes the formation of a peer review panel. The purpose of the peer review panel is to provide technical guidance in the development of the model system and to review the reasonableness of the output travel forecasts. The peer review panel is expected to enhance the credibility of the model development process by instituting an objective and independent review of models, assumptions, methodologies, and results. The peer review panel will provide comments on the model system design; the final model system; alternative definitions, pricing assumptions, other methodology assumptions; and forecasting results.

This report includes the draft model design and data collection plans, as well as a discussion of the performance measures that will be used in the evaluation. This document will be presented at the first meeting of the Peer Review Panel (of three total meetings), held on June 8, 2005. Based on the panel's recommendations, the final version of this report will be completed shortly thereafter.

2.0 Model Design

2.1 INTRODUCTION

Model Components

This section summarizes the model design for the Bay Area/California High-Speed Rail Ridership and Revenue Forecasting Study. The following components of the modeling approach for this project need to be considered:

- Urban travel;
- Intercity travel;
- External travel;
- Trip assignment; and
- Model validation and application.

Urban trips include all trips with both ends in one of the three urban areas with more than one proposed high-speed rail station. These areas are the San Francisco Bay Area, Greater Los Angeles, and San Diego regions. Sacramento has also been considered, since a second station in the Sacramento region is being considered. The metropolitan planning organizations representing these areas are the Metropolitan Transportation Commission (MTC), the San Diego Association of Governments (SANDAG), the Southern California Association of Governments (SCAG), and the Sacramento Area Council of Governments (SACOG). These urban areas are presented in Figure 2.1.

Intercity trips include all trips with both ends in California and whose origin and destination are in different urban areas having proposed high-speed rail stations.

External trips include trips with one end outside California and one end in an urban area with a proposed high-speed rail station.

We recognize that some urban trips may be longer than some intercity trips by this definition and vice-versa. These definitions do clearly fit in with urban and statewide planning definitions and do identify most intercity trips as those that begin or end outside an urban area. One example of an anomaly is a trip from Modesto to San Jose (defined as an intercity trip), which is similar in distance to a trip from Palmdale to Los Angeles (defined as an urban trip). Even taking these anomalies into consideration, there was consensus that the definition of urban and intercity trips fit well with the majority of trips in the system and that the models proposed for each would adequately address the behavioral nature of each trip type.

Trip assignment includes the merging of the urban, intercity, and external trips into a modal trip tables that are assigned to highway, rail, and air networks. These assignments will be validated in the base year and forecast year to evaluate reasonableness and accuracy compared to observed data sources. The base year will be 2005, but we will also prepare a year 2000 model run to compare with data sources that are from this year. Sensitivity tests will also be performed to ensure that the models capture behavioral changes to key parameters, such as time and cost.

Temporal Coverage

The California intercity models will explicitly model peak and off-peak travel for both urban and intercity trip movements. Consistent with most urban and statewide models, this model will estimate average weekday riders for the high-speed rail system. These average weekday riders will be converted to average annual riders using annualization factors developed from available high-speed rail systems around the world. If data is available to develop annualization factors by trip purpose, these will be used.

2.2 DATA SOURCES

The available data for model development include the following:

- 2001 California statewide household activity/travel survey contains household, person, and trip information for households throughout the State;
- 1995 stated-preference intercept travel surveys collected by Charles River Associates for the California High-Speed Rail Authority;
- Recent household travel survey data (within the past five or six years) from the large urban areas (MTC, SCAG, SACOG, and SANDAG);
- Revealed and stated-preference data collected for this study, including airport and rail passenger intercept surveys; and
- Data from the 2001 National Household Travel Survey (NHTS) for California.

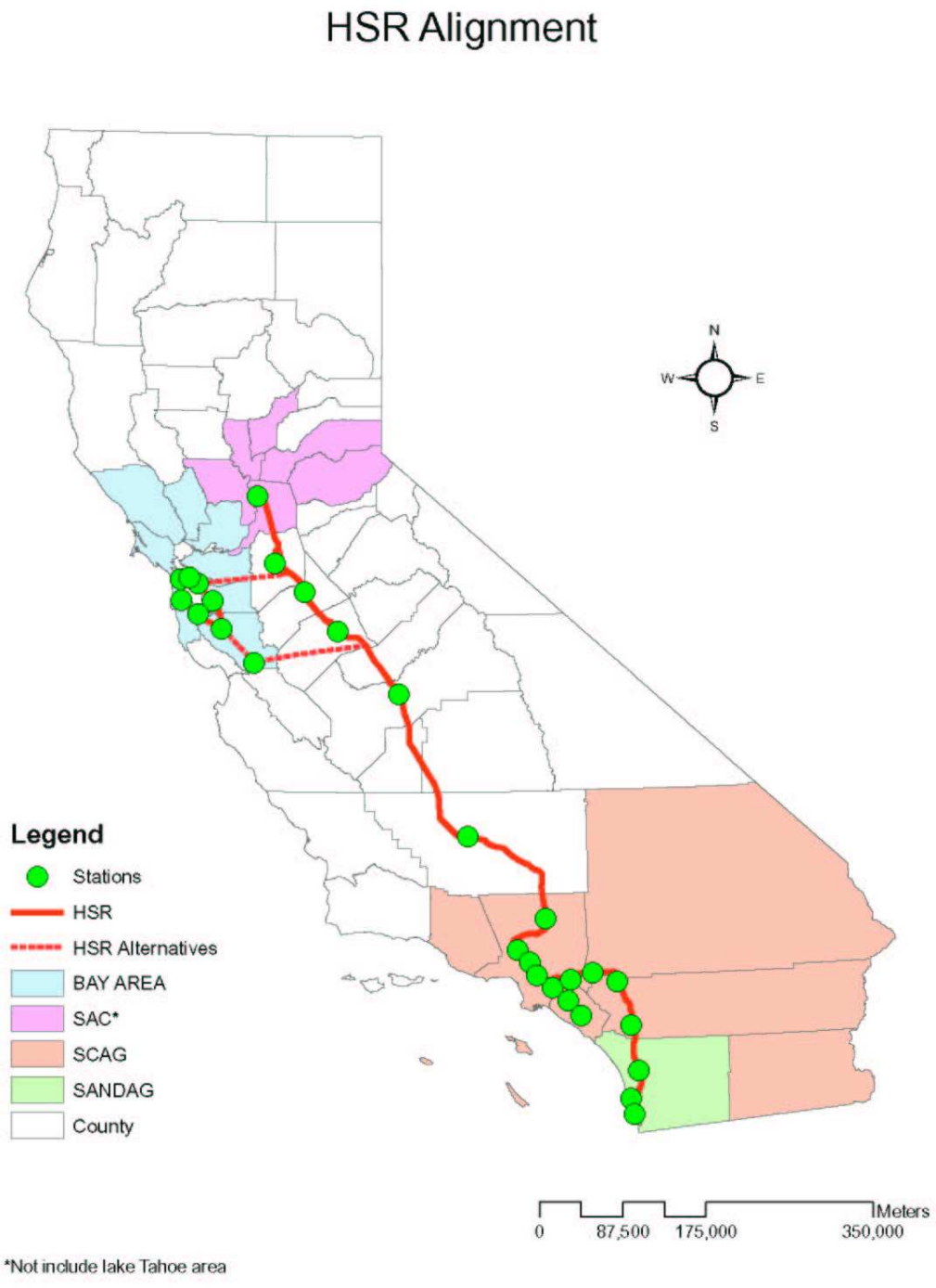
Several existing travel modeling tools in California are available for use. These include urban models for the four metropolitan planning organizations (MPOs) identified and the California statewide model.

Table 2.1 summarizes the expected data sources for the model system. These data sources are described in more detail as part of each model component.

Table 2.1 Expected Modeling Data Sources

	Intercity Travel	Urban Travel
Trip Table Model Estimation	• California Statewide Household Survey (1999)	• Regional models
Trip Table Model Validation	• Traffic count data • Ridership data • New household survey data • CHSRA household and intercept surveys (1995) • Select origin-destination surveys	• Regional models
Mode Choice Model Estimation	• New traveler intercept survey data • New household survey data	• Regional models • SCAG high-speed rail stated-preference survey data (2000)
Mode Choice Model Validation	• National Highway Travel Survey (2001) • Census Transportation Planning Package (2000) • Traffic count data • Ridership data	• Urban household survey data summaries • Census Transportation Planning Package (2000) • Traffic count data • Ridership data
Trip Assignment	• Traffic count data • Ridership data	• Traffic count data • Ridership data

Figure 2.1 California Urban Areas and HSR Station Locations



2.3 URBAN TRAVEL MODELS

Options for Urban Models

Urban travel will be considered only for those urban areas with more than one proposed high-speed rail station. These areas are presented in Figure 2.1 and include the MTC, SCAG, and SANDAG regions. We have also decided to include SACOG as an urban area, since there is a second station being considered in this region. The market segments for urban travel include the typical trip purposes for individuals on a daily basis since most travel made by urban area residents is made within the urban area. Trip purposes may include home-based work, school, university, shopping, social-recreational, pick-up and drop-off, and other trips as well as work- and non-work-related non-home-based trips. These trip purposes correspond to the purposes used in urban area models in California although the precise definitions and aggregations vary somewhat among the MPO models. The differences for the MTC, SCAG, SANDAG, and SACOG models are discussed in the next section.

For urban travel, the modeling options are:

1. Develop new models for urban travel (generally the same models would be used in all urban areas, or perhaps separate models for smaller and larger urban areas);
2. Use the trip generation from the three existing MPO models; develop new trip distribution and mode choice models (generally the same models would be used in all urban areas, or perhaps separate models for smaller and larger urban areas);
3. Use the trip generation and distribution from the existing MPO models; develop a new mode choice model; and
4. Use the trip generation, trip distribution, and mode choice from the existing MPO models.

Given that the trip purposes in the existing MPO models, although not entirely consistent with one another, correspond with those needed for the analysis of urban travel in this project, the MPO trip generation and distribution models are usable for this project. Developing original models would provide a higher level of consistency among the different urban areas, but in general similar trip tables to those in the existing MPO models would be expected.

The MPO mode choice models include a variety of transit modes, but not specifically a high-speed rail mode in any model, with the exception of the new SCAG mode choice model. The use of the other MPO mode choice models would therefore require adding a high-speed rail mode. The difficulty of adding such a mode is discussed below, and it would be exacerbated by the differences between all of the existing MPO mode choice models. A "generic" mode choice model, with transferred parameters, that could be used in all urban areas is

worth considering. The high-speed rail mode could be added to this generic model.

The main difficulty in estimating new urban mode choice models with a high-speed rail mode would be in obtaining sufficient data on urban travel. The MPO household surveys have no data on high-speed rail travel (although SCAG has conducted stated-preference surveys that include information on high-speed rail). The intercept surveys to be done in this project are focused on intercity travel, and so information on urban access to inter-urban transportation centers could be collected. But this would not include information on other urban trips unrelated to inter-urban travel. While it might be possible to collect some information on other urban trips made by these same travelers, this would represent a biased sample (only people who also make intercity trips, biased toward more frequent intercity travelers). Internet and telephone surveys could be used to collect information on urban travel, but most trips reported by the respondents would not be likely to be able to take advantage of the proposed high-speed rail lines.

To deal with the expected lack of data on urban high-speed rail usage, the work plan calls for examination of constants from models developed for other areas that consider high-speed rail as an option for urban travel. It is also possible to use other mode-specific model parameters. For example, in some cases, the Federal Transit Administration (FTA) has allowed the use of different in-vehicle time coefficients for premium transit modes, on the assumption that time spent in a comfortable train might be perceived more favorably than time spent in a less comfortable vehicle.

The recommendation is to go with option 3. The existing MPO trip generation and distribution models would be used – more specifically, the person trip tables from these models. This requires the simplifying assumption that there would be no new trips or changed destinations for urban travel associated with the implementation of high-speed rail. A new generic mode choice model would be applied in all urban areas, to which the high-speed rail mode would be added, based on information from other areas such as the new SCAG model, which is probably the best source for data concerning urban high-speed rail use.

Trip Purpose

The definition of trip purposes depends on those used in the urban models from which the trip tables will be obtained. The trip purposes for the three models are presented in Table 2.2.

Table 2.2 Trip Purposes in Urban Area Models

Trip Purpose	MTC	SANDAG	SCAG	SACOG
Work Purposes				
Home-based Work	✓	✓		✓
Home-based Work Direct			✓	
Home-based Work Strategic			✓	
School Purposes				
Home-based School (K-12)		✓	✓	✓
Home-based Grade School (K-8)	✓			
Home-based High School (9-12)	✓			
Home-based College	✓	✓	✓	✓
Other Purposes				
Home-based Shop		✓	✓	✓
Home-based Social-Recreational	✓		✓	
Home-based Other		✓	✓	✓
Home-based Shop/Other	✓			
Home-based Serve Passenger			✓	
Non-home Purposes				
Work-based Other		✓	✓	✓
Other-based Other		✓	✓	✓
Non-home-based	✓			

This leads to the definition of five trip purposes for the urban models:

- Home-based work;
- Home-based school (grades K-12);
- Home-based college;
- Home-based other; and
- Non-home-based.

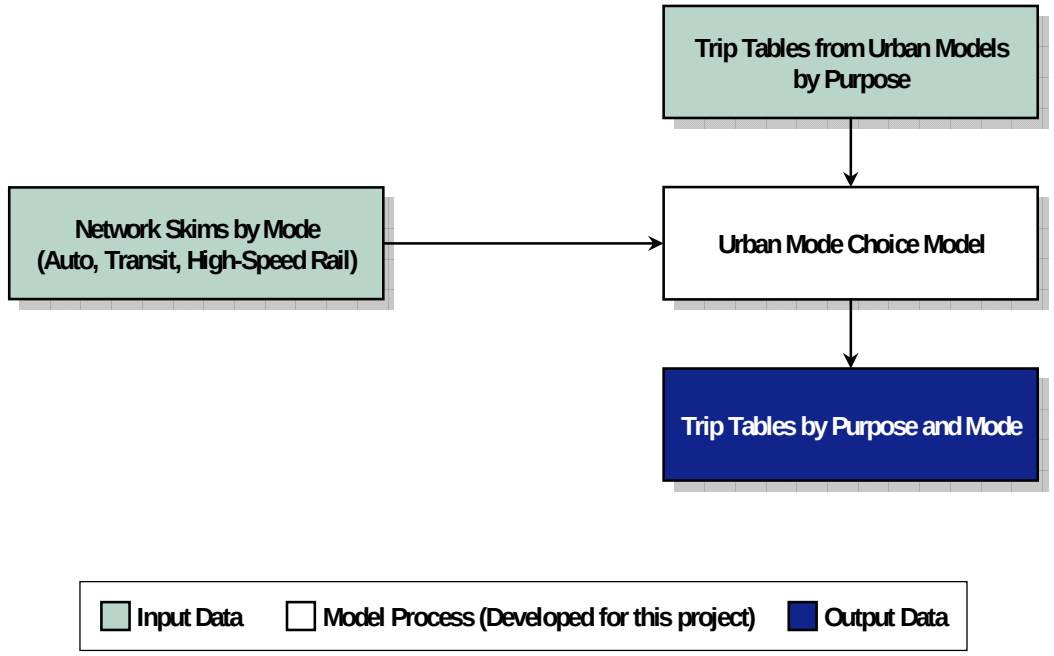
This set of trip purposes means that a trip table or combination of trip tables from each urban model can be used to develop the appropriate trip table for this project. For example, the SCAG home-based shop, home-based social-recreational, home-based serve passenger and home-based other trip tables can be combined to create the required home-based other trip table for this project.

Similarly, the SANDAG work-based other and other-based other trip tables can be combined to create the required non-home-based trip table for this project.

Recommended Urban Model Structure

Figure 2.2 shows the proposed urban model structure.

Figure 2.2 Urban Modeling Process



Mode Choice Model

The definition of modes for the mode choice model also depends on those used in the urban models. The SCAG mode choice model is currently under development, but it is known that it will include a high-speed rail mode. The MTC model has a less detailed list of modes than the SANDAG model. The modes in the MTC model include drive alone, two (2)-person shared ride, three or more (3+)-person shared ride, transit-auto access, and transit-walk access. Along with the high-speed rail mode, this set of modes should comprise the alternatives in the mode choice model:

- Drive alone;
- Two (2)-person shared ride;
- Three or more (3+)-person shared ride;
- Transit-auto access;
- Transit-walk access;

- High-speed rail-auto access; and
- High-speed rail-walk access.

As part of the model development, it makes sense to test whether keeping the three auto modes separate has a significant effect on the estimates of high-speed rail demand. If it is found that keeping the auto modes separate has an insignificant effect on high-speed rail demand, a single auto mode may be used.

Mode choice models will be developed for all trip purposes except school trips, since these trips are not likely to include high-speed rail alternatives. Instead, the home-based school trips will be estimated from the MPO models and subtracted from the urban trip tables so that these trips are not misrepresented in the resulting highway and transit assignments.

Since the mode choice models for the three MPO models differ in terms of variables used and parameters, it is proposed that a single generic mode choice model be developed for urban travel. This will be a nested logit mode choice model and will include level of service variables, with composite parameters transferred from available mode choice models (i.e., from the three urban areas). There is considerable information available on model parameters from other areas, including previous research by Cambridge Systematics and guidance from FTA. The use of the SCAG model to obtain parameters for analyzing high-speed rail travel may indicate that the parameters from that model may be the most appropriate; however, since this model has not yet been estimated, it must be reviewed prior to making any final decisions about its use in this project.

Model calibration will include an evaluation of the values of time for each trip purpose in the model and the relative weights of coefficients on out-of-vehicle and in-vehicle time. Sensitivity tests will also be performed to evaluate the impacts of key parameters, such as time and cost, to ensure that the models respond in an expected manner.

Stratification by income level in the mode choice model can be considered; however, the existing trip tables from the three MPO models do not use consistent definitions of income levels. These income groups are presented in Table 2.3. Redistributing the income groups/trip tables from the other models into the MTC income groups by using some simple factors may be feasible option. The obvious strength of income stratification is the ability to predict the extent urban commuters with relatively high VOT switch to HSR.

Table 2.3 Income Groups in Urban Area Models

Income Group	MTC	SANDAG	SCAG	SACOG
Low income				<$10,000
Low-medium income	<$25,000	<$25,000	< $25,000	$10,000-$20,000
Medium-low income				$20,000-$30,000
Medium income	$25,000-50,000	$25,000-75,000	$25,000-$50,000	$40,000-$50,000
Medium-high income	$50,000-75,000		>$50,000	>$50,000
High income	$75,000	>$75,000		

The level of service inputs to the mode choice models will be obtained by skimming the highway and transit networks in the MPO models. The proposed high-speed rail service between stations in the urban areas will be coded into the transit networks for these models.

Induced Travel

The existing urban area models do not currently contain the capabilities to estimate induced travel directly, so we propose to estimate induced demand for urban area models outside the proposed modeling system. By consensus, the induced demand will be estimated only for two stations, Palmdale and Temecula, as these are the only stations that are likely to have significant induced travel. This process will identify economic growth potential from land uses locating around high-speed rail stations, rather than induced travel from existing populations making additional trips.

2.4 INTERCITY TRAVEL MODELS

Options for Intercity Models

The market segments for intercity travel include business-related trips, commute trips, vacation travel, other recreational trips, and other trips. It is important to treat these purposes separately since the various markets have very different characteristics – such as reimbursement for travel expenses, travel party size, etc. – that can have a significant effect on travel decisions. It is important to note that the project work plan also includes consideration of "induced intercity demand."

Generally, the MPO models will not be useful in estimating intercity travel because of their limited geographic ranges. The only existing modeling tool that provides the necessary geographic range is the California statewide model.

However, the trip purpose definitions in the statewide model are inconsistent with the market definitions discussed above. In addition, the existing statewide model does not consider induced demand.

For intercity travel, the modeling options are:

1. Develop our own models for intercity travel;
2. Use the trip generation from the statewide model; develop our own trip distribution and mode choice models;
3. Use the trip generation and distribution from the statewide model; develop our own mode choice model; and
4. Use the trip generation, trip distribution, and mode choice from the statewide model.

For option 1, possible data sources for the trip generation and distribution models would be the surveys conducted for this project and the statewide household travel survey. This is the same data source as for the existing household survey, but new models could reflect the travel markets needed for the high-speed rail study. Option 2 really does not make sense since if the existing statewide trip generation model were to be used, the distribution model would have to use the same trip purposes, and that would essentially be recreating the existing statewide trip distribution model. Regarding option 4, the existing statewide mode choice model does not include high-speed rail as a mode, and it makes more sense to develop a mode choice model from the revealed and stated-preference survey data the project is already planning to collect. It should also be noted that if the trip generation from the existing statewide model were to be used (option 2, 3, or 4), that model does not consider induced demand as the trip generation is based only on fixed demographic forecasts and not any measures of accessibility.

Based on the need to define the correct trip purposes for intercity travel and the need to consider induced demand, option 1 appears to be the best. New trip generation and distribution models would be developed from the surveys conducted for this project and the statewide household travel survey.

Trip Purposes

The most critical question for the intercity model structure is the definition of trip purposes that can be supported by the available model estimation data sets. The two data sources are the 2001 California statewide household activity/travel survey data set and the 2001 NHTS data set. We identified 5,501 trips between defined areas within the State, in the 2001 California statewide household activity/travel survey. Figure 2.3 shows the defined subregions used to determine the intercity trips in the California statewide household activity survey.

Figure 2.3 California Subregions and Proposed HSR Station Locations

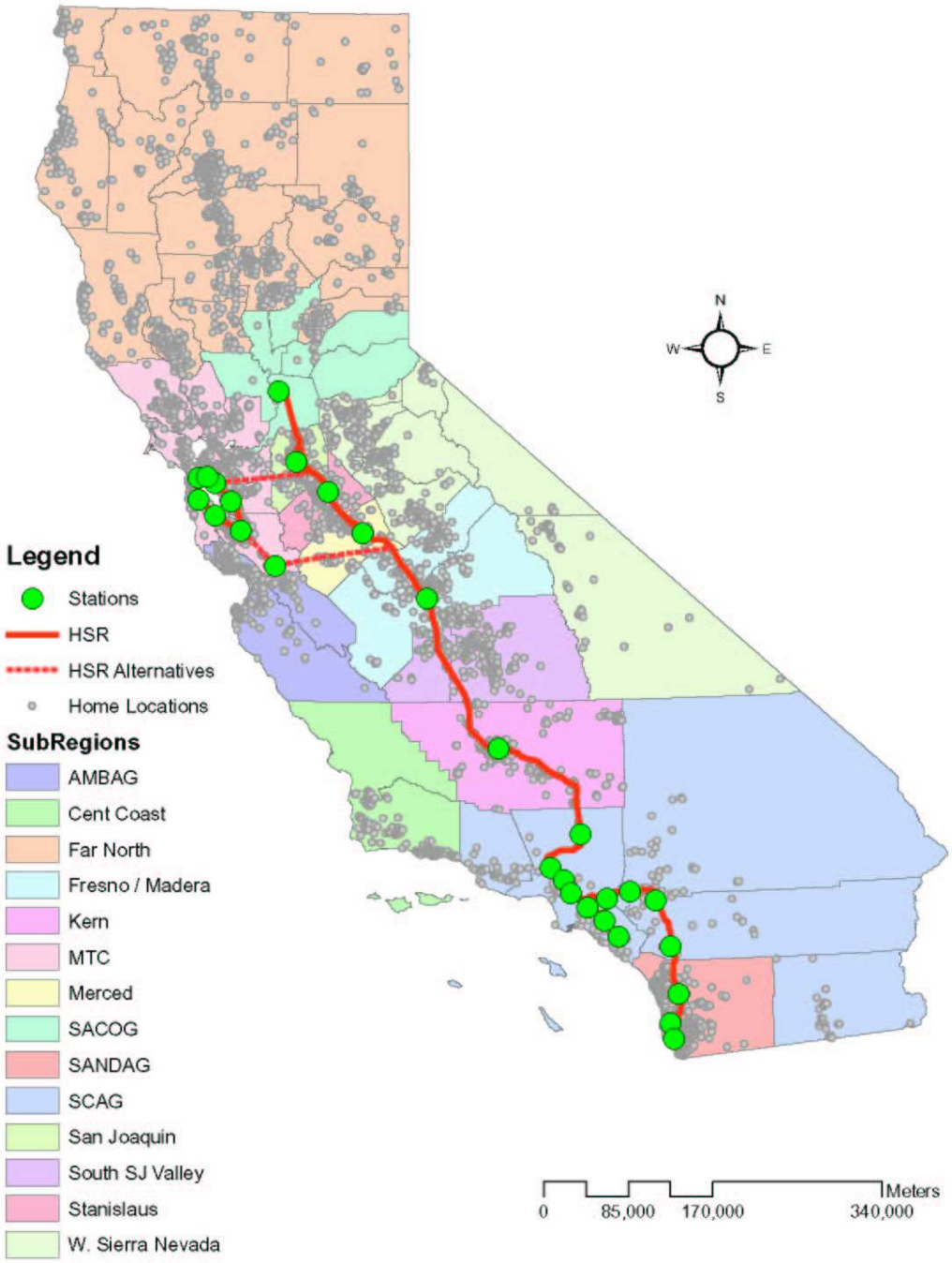


Table 2.4 show the number of persons with zero, one, and two or more intercity trips for the business/commute, vacation/recreation, and other trips from the California survey. These tables indicate that although the vast majority of persons made no intercity trips, there still appear to be enough persons who made such trips to develop intercity trip generation models from this data set.

Table 2.4 Number of Intercity Trips Per Person by Purpose

Trips/Person	Number of Persons	Percentage of Persons
Number of Commute Trips per Person		
0	39,653	98.77%
1	148	0.37%
2+	344	0.86%
Number of Business Trips per Person		
0	39,420	98.19%
1	219	0.54%
2+	508	1.26%
Number of Recreation Trips per Person		
0	39,004	97.2%
1	685	1.7%
2+	456	1.1%
Number of Other Trips per Person		
0	39,170	97.6%
1	499	1.2%
2+	477	1.2%

Source: 2001 California Statewide Household Travel Survey.

Some other notes from this survey data set:

- Over 90 percent of the recreation trips were classified in the data set as "other recreation." There are clearly not enough vacation trips in this data set to consider them as a separate trip purpose for model development.
- About 40 percent of the total work trips are commute trips, while the remaining 60 percent are business trips. These are separated based on the classification of the destination as the person's work place (i.e., commute) or not (i.e., business).

The NHTS data set for California does not have enough geographic specificity to determine without question whether a trip is intercity by our definition. But there is a data set containing a retroactive survey of a month's worth of long-distance (greater than 50 miles) trips from respondents. This data set contains

2,913 trips: 1,212 business/commute trips, 1,078 vacation/recreations trips, and 623 other trips. The main advantage of this data set is that about half of the business/commute trips are business trips and half are commute trips, leading to the possibility that these purposes could be separated. However, not all intercity trips are included in this data set (trips under 50 miles are excluded), and some of these trips may be urban trips. As a result, it will be best to reserve this data set as a possible validation data source.

The final set of trip purposes for intercity models is proposed as:

- Business/commute;
- Vacation/recreation; and
- Other.

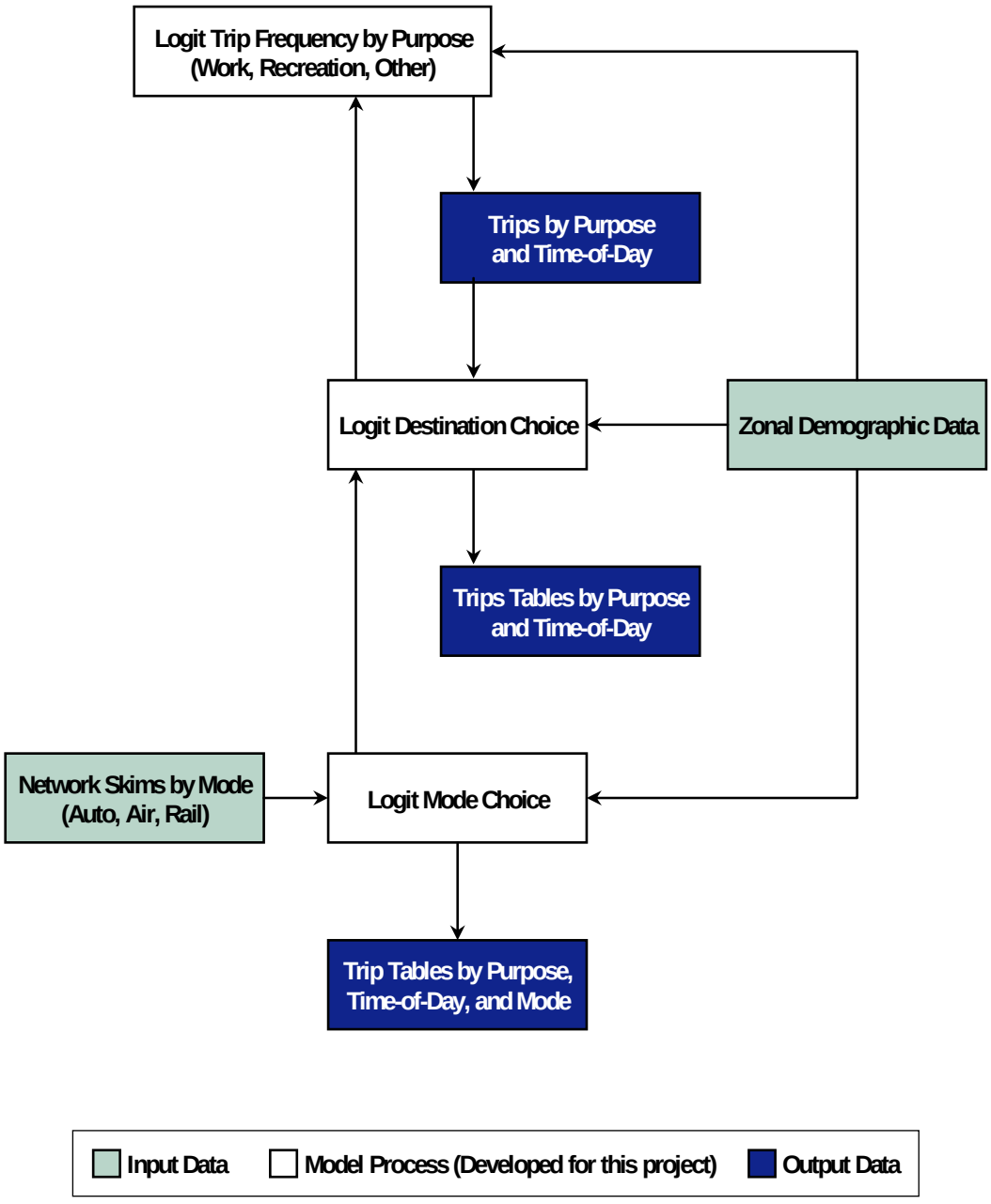
Recommended Intercity Model Structure

All of the intercity model components will use a logit formulation so that logsum variables representing composite impedance and accessibility can be used in upper-level models. Figure 2.4 shows the proposed model structure.

The trip generation and destination choice models would be estimated from the 2001 California statewide household activity/travel survey data set. There are 5,479 intercity trips available for this purpose (1,366 business trips, 927 commute trips, 1,672 vacation/recreation trips, and 1,514 other trips). This is enough samples to estimate both trip generation and distribution models using the logit formulation. Trip generation variables, besides the destination choice logsum, would include demographic variables related to characteristics of the traveler and his household. Note that the trip generation models are proposed to estimate the number of intercity trips per person, not per household. Demographic variables would also be used in the destination choice models, along with the logsum from the mode choice model, which would represent composite impedance between zones.

It is important to note that the portion of the California survey data set to be used for the estimation of these models will include all intercity trips, as defined for this project (trips with one end in one urban area and in another). High-speed rail might not be a feasible mode for some of these trips. For example, there are some trips where both trip ends are far from the proposed stations, meaning that both auto access and egress could be required. The mode choice model will be used to determine which trips would be able to use the proposed high-speed rail service.

Figure 2.4 Intercity Modeling Process



The mode choice models will be estimated from the data set from the stated-preference surveys of existing intercity travelers. These models will be nested logit models and will include variables related to the levels of service (times and costs) of the various modes, including at least auto, air, and rail. The new mode choice models will also take advantage of RP data among the existing modes on the same trips that are the basis of the SP – they will be RP/SP models. The RP

data will be particularly useful to estimate the mode constants for the existing modes.

Induced Travel

Induced intercity demand for high-speed rail can be estimated through the use of the logsum variable being fed from the destination choice model to the trip generation model. This variable would represent the accessibility of all destinations; the introduction of high-speed rail would create additional accessibility, potentially resulting in more estimated trips.

A second component of induced travel, resulting from potential changes in land use due to the location of a high-speed rail station, would be estimated from a separate analysis of economic development factors, resulting in changes in socioeconomic forecasts. These new socioeconomic forecasts would be used as input to the new statewide model, potentially resulting in additional high-speed rail trips.

2.5 MODEL AREA AND EXTERNAL TRAVEL

The proposed high-speed rail system will have stations only in the State of California. None of the stations are located near the California border, except in San Diego. This means that any external high-speed rail trips (those with one end outside California) can be defined as having two components: a relatively long access/egress trip between the out-of-state origin/destination and a proposed high-speed rail station that would use another mode, such as air, auto, or bus, and a trip segment between two locations near proposed high-speed rail stations.

The existing survey data sets have relatively few of these trips, mainly those that are made by California residents to out-of-state locations. The specific locations of the out-of-state trip ends would be difficult or impossible to obtain from these data sets. So any estimation procedures for high-speed rail demand for external trips could not be developed from these data sets.

The best source for information on external trips that might use high-speed rail would be the intercept surveys (such as the airport surveys) that would be conducted for passengers traveling between locations where high-speed rail would be offered. It would not be possible to generate a complete set of external trips from the intercept survey data, but it would be possible to estimate the number of external trips between proposed high-speed rail station locations relative to the number of internal trips (those with both ends inside California), which would be estimated through the proposed intercity travel model.

It is proposed that adjustments to reflect the external trips that could potentially use the proposed high-speed rail system be made to the trip tables that are the outputs of the intercity modeling process. These adjustments would be made

based on the results of the intercept surveys. The adjusted trip tables would then be used as inputs to the intercity mode choice model.

One specific exception to this proposed approach is the Tijuana Trolley, which connects downtown San Diego with the Mexico border. This border location will be viewed as an external, and travel demand data on the Tijuana Trolley will be obtained from SANDAG and included in our urban area model trip tables.

The model area for the intercity models therefore will be the State of California. While it is true that there are some parts of the State that would not be directly served by the proposed high-speed rail system, it is proposed to generate intercity trips for all urban areas of the State and to allow the mode choice model to estimate which trips could potentially use the high-speed rail mode.

2.6 TRIP ASSIGNMENT

Merging Urban and Intercity Trips

Trips will be combined from the urban and intercity models into a daily trip table for each mode including all trip purposes. At this time, the urban trip tables will be aggregated to statewide modeling zones. Once the trip tables have been merged into a single trip table by mode, each mode will be assigned to its respective network (highway, rail, and air).

Time Periods

It would be desirable to apply the mode choice model to separate trip tables by time period, to account for differences in levels of congestion, existing transit service, and proposed high-speed rail service. After some discussion, we propose to model two time periods: peak and off-peak. We will review train schedules in France and Japan to determine if there are any significant differences in frequency between the a.m. peak and the p.m. peak, but the modeled time peak time period will be both peak periods combined. The time period definitions will be determined by the urban area models, as presented in Table 2.5.

Table 2.5 Time Periods in Urban Area Models

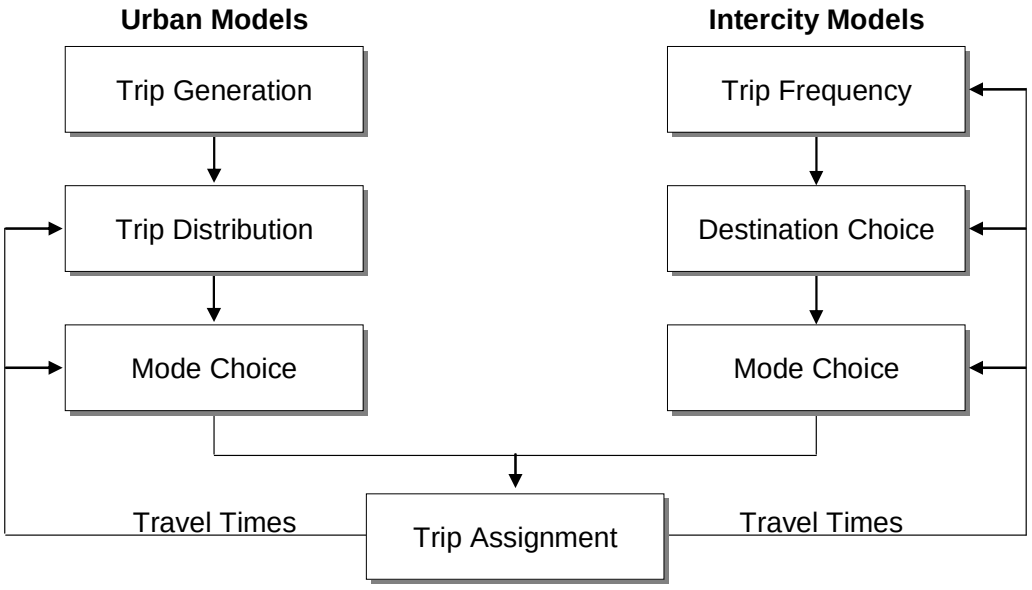
Time Period	MTC*	SANDAG	SCAG	SACOG
A.M. Peak	6:30 am to 8:30 p.m.		6:00 a.m. to 9:00 a.m.	6:45 a.m. to 9:45 a.m.
Midday	Remainder		9:00 a.m. to 3:00 p.m.	9:45 a.m. to 2:45 p.m.
P.M. Peak	Remainder		3:00 p.m. to 7:00 p.m.	2:45 p.m. to 5:45pm
Night	Remainder		7:00 p.m. to 6:00 a.m.	5:45 p.m. to 6:45 a.m.

*MTC has time-of-day peaking factors that can be used to create trip tables by time period, but they currently only estimate a.m. peak and off-peak assignments.

Feedback

Trip assignment uses travel times from the trip distribution models as a starting point to determine the impacts of trips on congestion and the resulting congested travel times. In this travel demand forecasting system, we propose to iterate between the trip assignment and other model components (trip generation, distribution, and mode choice) until the travel times for each model component are reasonably consistent. Figure 2.5 presents the feedback from trip assignment to each modeling component in the high-speed rail modeling system.

Figure 2.5 High-Speed Rail Modeling System Feedback



2.7 MODEL VALIDATION AND APPLICATION

The validation of the model will ensure that overall travel demand is reliably captured for intercity trip movements in the State of California and that mode shares are reasonably estimated and have appropriate sensitivities to key variables. Since there is currently no high-speed rail mode in California, the actual mode share for this cannot be validated. But we can also review mode shares for existing systems in France and Japan to determine if the forecast mode shares are reasonable. It is for that reason that model validation will include reviewing base year traffic volumes and ridership as well as reviewing a forecast year baseline model, with and without high-speed rail.

Urban Models

The trip generation and distribution models from the four urban areas are being used directly, under the assumption that these models have been validated for use in planning applications. This validation will be reviewed prior to use in this project.

The mode choice models from the four urban areas are being adapted for use in this project, and as such will be validated against available observed data summaries on mode shares in the region, as well as against traffic counts and ridership counts in each region. This validation will be done at an aggregated level, primarily oriented around screenlines into and out of each region, since these are the trip movements that would be affected by high-speed rail.

Intercity Models

The trip frequency and destination choice models will be validated against four data sources:

- 1995 stated-preference surveys conducted for the CHSRA;
- 2001 National Highway Travel Survey conducted for FHWA;
- 2000 Census Transportation Planning Package (CTPP); and
- Selected origin-destination surveys conducted at key locations (such as the SCAG external surveys, the SR 152 surveys in Los Banos, and the San Joaquin Valley surveys on the Altamont Pass).

The CHRSA surveys contained a large sample of intercity trip movements in California. There were four components to this survey, as follows:

- Household total travel survey with 15,713 samples;
- Air and rail intercept surveys with 1,495 and 2,818 samples, respectively;
- Private vehicle travel survey with 1,983 samples; and
- Quality of service survey with 957 samples.

This validation will allow us to confirm that the use of a relatively small sample of trips used in the estimation of the trip frequency and destination choice models was sufficient for replicating travel behavior. In addition, it may provide an understanding of the reliability of the forecasting of these trips, since this comparison will be based on 10-year old data. We believe this dataset will be quite useful for validating the trip frequency and destination choice models.

Both the 2001 NHTS and the 2000 CTPP will be used to verify trip frequency, destination choice and can also be used to verify mode choice. The CTPP will only be used to confirm commute travel. Because the mode choice travel behavior has not been as stable during the 10-year period since the 1995 CHSRA stated-preference surveys (because of 9-11), we will not use this survey to validate the mode choice results. Instead, traffic counts and transit ridership counts can be used to assist in validation of the intercity mode choice model results. The selected origin-destination surveys are all auto intercept surveys, so these can be used to confirm destination choice of highway trips, but not for trip frequency or mode choice models.

Trip Assignment

There will be assignments of highway, rail and air trips on individual networks for model validation and these will be compared to traffic and ridership counts, respectively. Validation will include reviewing both base year and forecast year volumes for reasonableness. Base year volumes will be compared directly to counts for screenlines. If there is a discrepancy between validation of the trip frequency and destination choice models and the traffic and ridership counts, the validation will use traffic and ridership counts as the controlling factor.

Since these models are estimating intercity trip movements, systemwide measures such as vehicle-miles traveled will be estimated, but will not be validated against existing data, since these will include all travel rather than just intercity travel. Nonetheless, this and other systemwide measures will be reviewed for reasonableness.

Travel times by mode are an important component of the modeling system and will be reviewed for reasonableness and checked against any available observed data sources on average speeds or speeds at an individual location. In the case of the highway mode, free flow and congested travel times will be checked for reasonableness.

3.0 Data Collection Plan

3.1 INTRODUCTION

The California High-Speed Rail model design will require the use of several existing data sources, as well as the collection of new survey data. This section describes the new survey data collection that will support the development of new intercity mode choice models and the validation of intercity trip generation and distribution models. The use of the other data sources is described in model design section of the report.

We expect to use a combination of intercept surveys and household surveys to obtain the new data needed for the study. The intercept surveys will primarily be used to obtain revealed-preference (RP) and stated-preference (SP) mode choice data from air and rail passengers, while the household surveys will be used to obtain similar mode choice data from recent intercity auto travelers and to obtain trip pattern data which may be used to validate the trip generation and distribution models that will be developed using the statewide household survey data.

Background

The 1995 CHSRA stated-preference travel surveys conducted by Charles River Associates (CRA) were panel-based mail household surveys that provide a robust source for analyzing California residents intrastate trip patterns. The dataset includes intercity trip data for more than 15,700 households. The survey had a solid response rate of around 59 percent, and an excellent representation of trips by households of differing income and geographic strata. The dataset will provide an ideal means for validating the trip frequency and destination choice models. The estimated models can also be validated against the NHTS dataset and against available transportation flow data (U.S. DOT air travel data; Amtrak data; highway O-D survey data; highway traffic count data).

The CRA data were collected in May of 1995, so we will need to develop level-of-service data for the intercity modes from the CRA study and from public data sources. The models will be completely disaggregated, and will relate travel decisions to the specific characteristics of the households and to the service levels. The implicit assumption of using the models to forecast travel well into the future is that the basic relationships between household characteristics, levels-of-service, and intercity trip-making remain the same even though household characteristics and transportation service levels vary. If we are to make this assumption for the period of the present to 2040, then one would also believe that it would be reasonable for the period from 1995 to the present.

Intercept Surveys

We propose to concentrate our intercept surveys on corridor air and rail passengers. We had originally also considered performing intercept surveys of intercity bus riders, but we do not recommend doing these again for the following reasons:

- Past high-speed rail studies have found that intercity bus riders were the least likely of the users of public modes to switch to high-end rail services because they tend to seek the lowest-cost means of travel.
- Earlier this month, Greyhound Lines restructured many of their California routes. Since some of the changes are somewhat controversial and involved the elimination of some service, it is less likely that the carrier will be predisposed to cooperate with our efforts to perform market research at this time. In addition, the changes may mean that passengers are less familiar with the intercity bus options.
- In a past study, where we were able to obtain the cooperation of Greyhound Lines' parent company, Laidlaw, to perform surveys of their passengers, we needed to agree to limit the dissemination of the survey data and models derived from them. In the view of the modeling team, if we need to follow similar restrictions, it would be much more difficult to deliver a multiuser model system.

We also considered the use of vehicle intercept surveys as a means to collect intercity auto trip information. However, to obtain a representative sample of intercity trips with these surveys would require a massive new survey effort with a great number of survey sites and video data collection. The cost and time of completing these surveys would be substantially more than the alternative household surveys, so we recommend doing the household surveys instead of vehicle intercept surveys.

3.2 AIRLINE PASSENGER INTERCEPT SURVEY

Objective

Collect RP/SP mode choice model estimation data.

Sampling

Although the list of airports may change based on the level of cooperation we receive, we are currently investigating how to obtain permission to conduct intercept surveys in airport destination lounges at:

- San Francisco (SFO);
- Oakland (OAK);
- San Jose (SJC);

- Sacramento (SMF);
- Fresno (FAT); and
- Los Angeles (LAX).

We had also sought to survey at San Diego International (SAN), but airport staff would not grant us permission to do the intercept surveys in departure lounges. Oakland airport (OAK) has also not been cooperative in allowing surveys in the airport, but we are pursuing additional contacts at Oakland to receive permissions.

Table 3.1 summarizes the in-state destinations served by the airports proposed for the survey, as well as those of other corridor airports. Based on where we receive permissions to conduct the surveys, we will capture the majority of in-state destinations with these airports.

We are developing a flight sampling plan using data from the Official Airline Guide (OAG) and information about connecting and local traffic percentages from the U.S. DOT airline data. All relevant in-corridor direct flights will be included in the sampling frame. Each flight will be weighted by estimates of the number of available seats multiplied by the percent of origin-destination travelers for the route (from U.S. DOT T-100 data). We will then draw a sample of flights based on the flight weights. The selected flights may be adjusted to improve the efficiency of data collection, but we will try to replace flights with others from the same airline and the same aircraft type (jets; regional jets; turboprops).

Relevant airport destinations include: Bakersfield (BFL); Burbank (BUR); Fresno (FAT); Long Beach (LGB); Los Angeles International (LAX); Modesto (MOD); Ontario (ONT); Orange County (SNA); San Diego (SAN); Santa Barbara (SBA); SMF (for Bay Area airports); SFO (for Sacramento). At least one flight from each airport origin-destination pair will be included in the sample.

The model design assumes that the models will be based on weekday trips only. Therefore, the survey data collection will take place on Monday through Thursday.

Table 3.1 California Destinations Served by Corridor Airports

Airport	Total Daily Flights	Total Direct Destinations	HSR Corridor Destinations	Other California-Serving Destinations
San Diego (SAN)	484	74	LAX; OAK; SMF; SFO; SJC	IPL; MRY
Sacramento (SMF)	280	54	BUR; LAX; ONT; SNA; SAN; SFO	CEC; ACV; PSP
San Francisco (SFO)	1,345	126	BUR; FAT; LGB; LAX; MOD; ONT; SNA; SMF; SAN	BFL; CEC; MRY; PSP; SBP; SBA; RDD; ACV
San Jose (SJC)	298	59	BUR; LAX; ONT; SNA; SAN	SBA
Oakland (OAK)	377	66	BUR; LGB; LAX; ONT; SNA; SAN	PSP
Los Angeles (LAX)	2,174	167	FAT; OAK; ONT; SNA; SMF; CLD; SAN; SFO; SJC	BFL; IPL; IYK; MRY; OXR; PSP; SBA; SMX; VIS
Ontario (ONT)	189	39	LAX; OAK; SMF; SJC	None
John Wayne (SNA)	268	51	LAX; OAK; SMF; SFO; SJC	None
Long Beach (LGB)	50	15	OAK	None
Burbank (BUR)	160	29	OAK; SMF; SFO; SJC	None
Fresno (FAT)	74	15	LAX; SAN; SFO	PSP; VIS
Modesto (MOD)	4	1	SFO	None
Carlsbad (CLD)	8	2	LAX	None

Survey Method

Assuming we obtain the necessary permissions, we propose to field test two survey methods. We will then select the best approach based on the efficiency and data quality from this pretest comparison. The two alternatives are summarized below.

Table 3.2 Alternative Survey Protocols

Survey Steps	Protocol #1: Mail-Out/Call-Back	Protocol #2: On-site
Arrival	Teams of two to four interviewers will arrive at the departure gates for sampled flights 75 minutes prior to departure and identify themselves to airline gate agents.	
Screening	Interviewers will approach air passengers in the departure lounges for the selected flights and determine whether the passenger is on the sampled flight and whether they are an originating passenger destined for the flight's destination city region (as opposed to a connecting passenger).	
Recruitment	Eligible originating passengers will be asked a small number of classification questions, including frequency of travel between the flight's airport pair, party size, and purpose of the trip.	
Collection	The interviewers will collect these data by personal interview when possible, but they will also have self-administered forms to handout to potential participants who would prefer to do the survey themselves or who do not have time to complete the interview prior to the pre-boarding call. The interviewers will try to collect the completed self-administered forms, but the forms will include a business-reply mail option for those that are not collected at the airport.	The respondent will then be asked to take a printed survey from the interviewer and to either complete it while they wait to board and return it to one of the surveyors, mail it back to us, or to allow us to call them to collect their responses at a day and time of their choice.
Contact Information	At the end of the interviews and at the end of the self-completion form, the respondents will be asked for their cooperation in completing a survey that will be mailed to them. They will be asked for mail and telephone contact information, and a good time to contact them by phone.	Interviewers will collect the necessary contact information from willing participants.
Completion	When the flight begins the pre-boarding and boarding process, interviewers will stop soliciting new people, and will simply collect completed self-administered forms.	
Passenger Counts	Once the flight is fully loaded, interviewers will ask gate agents for the total number of passengers that boarded, and will collect any self-completion forms that have been discarded in the lounge area.	
Mail-out	Respondents who have completed the interview or the self-completion survey will be mailed a customized stated-preference survey to complete.	Respondents that have not returned a questionnaire in person or by mail will be contacted by phone at the arranged times to provide the questionnaire information.
Call-back	These respondents will be contacted by phone at the arranged times to provide the questionnaire information. Respondents who did not receive a mail questionnaire or have lost it will be re-sent a copy of it, and will be re-contacted by phone. We will not be able to call respondents who are willing to provide address information without a telephone number, but we will send a follow-up mail survey to those who we do not hear from.	

The mail-out/call-back protocol has several methodological advantages that may improve data quality, including:

- Respondents will have completed their trip prior to needing to answer questions about it, so none of the data will be speculative.
- Respondents will have more time and better conditions to evaluate complex questions, such as the stated-preference exercises.
- The survey questionnaire may include more detail than the intercept-return version.
- The separate mail survey can more easily accommodate different questionnaire versions, and does not rely on interviewers to sort through multiple versions.
- The longer self-completion survey of Protocol #2 will have more refusals and break-offs, and these events may have a Domino effect on passengers in a small space where they can easily observe others.
- The stated-preference exercises can be customized to relate to the specific trips that were being made by the respondents. Some customization is possible for the intercept-return protocol, but this is limited by the practical capabilities of interviewers.

But, on the other hand, the on-site protocol is likely to be less expensive per completed interview than the first, and will allow us to collect at least some of the data directly at the airport. The on-site protocol also gathers information from respondents closer to their actual mode choice decision. In some ways, the respondents' expected service levels are more important than those actually encountered, so gathering data prior to the flight could be desirable. The potential methodological advantages and disadvantages need to be weighed against the higher costs. The air passenger survey pretest will allow us to make a judgment about this tradeoff.

Prior to the full fieldwork effort, we will assemble a detailed survey operations plan that interviewers will use as a guide. This document will describe the contingency plans for canceled and delayed flights, and will describe the destination lounge procedures in detail. Interviews and survey instruments will be provided in English and possibly Spanish.

We expect that the mail-out/call-back protocol will take five to seven minutes to recruit each respondent and 12 minutes to collect the data over the phone. The on-site protocol will take approximately 15 to 18 minutes to complete.

Sample Size

The required sample sizes for stated-preference models are difficult to know in advance of the surveys. Thus, we have made our estimates based on project team experience and rules-of-thumb. It is possible that models may be

developed from fewer samples, so the sample sizes provided below should be viewed as targets, rather than strict quotas.

To develop the stated-preference exercises, we would like to obtain at least about 100 responses for each of the key market segments we are evaluating (such as the three intercity travel purposes identified in the modeling plan business/commuting, vacation/recreation, other) for the two most commonly used modes (air and auto) and another 75 per market segment for the rail mode.

The trip purpose distribution of corridor air travelers developed from previous survey efforts provide some guidance on how the intercepted trips will be distributed and therefore can be used to determine the overall sample size for the survey.[1] However, because the actual market segmentation may vary from that which was proposed, we propose to establish the sample size based on the assumption that the smallest market segment that we will model separately from other segments will make up at least 15 percent of the intercepted air trips.

Assuming the 15 percent threshold, we will need about 600 completed total air passenger surveys to get the 100 completed surveys for each market segment. For estimating purposes on the first protocol, we are assuming that a 50 percent recruitment "overage" will be required. That is, if 600 completed SP interviews are required, we would need to recruit approximately 900 respondents who provide contact information and agree to participate in the follow up survey.

A crew of five surveyors would be used to conduct this airport survey. Generally, these interviewers will consist of two teams of two persons each, and one working supervisor who will conduct surveys when possible, provide assistance, and oversee the work. Because of the differences between airports and flight schedules, the number of recruited surveys that will be conducted will vary significantly by time and by survey site. However, on average we estimate that each interviewer will be able to conduct approximately 35 recruit surveys per shift (five-hour shift). This equates to about 140 recruit surveys conduct each day by our crew of four interviewers. In order to meet or exceed our recruitment goals, we plan on scheduling a total of eight to 10 days of interviewing among the five airports we are targeting (about two days of interviewing at each airport).

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[1] For the air passenger surveys, we expect that the respondents will be distributed by trip purpose as follows:

- Fifty-three percent business/commuter;
- Thirty percent vacation/recreation; and
- Seventeen percent other.

These estimates were derived from the 53 percent to 47 percent business/non-business split measured in the previous high-speed rail surveys, and the 63 percent to 37 percent vacation/other non-business trip split measured by NHTS.

On the on-site protocol, the pretest will need to be conducted to determine the share of respondents who will be willing to do the full SP survey while they are waiting compared to those who we will recruit and re-contact (as in Protocol #1). In general, there will be some efficiency realized by not having to re-contact some of these respondents. However, it is likely that the number of surveys (recruit surveys and full surveys) collected per shift may drop significantly. This would probably necessitate extending the number of days that interviews are scheduled at each of the airports we are targeting.

Survey Content

The proposed data elements for the air passenger survey are shown below:

Initial Interview

- Confirmation of flight;
- Connecting from another flight on origin end (if yes, terminate);
- Connecting to another flight on destination end (if yes, terminate);
- Frequency of flying between origin and destination airport;
- Trip purpose (three categories);
- Total number of party members; and
- Willingness to complete a survey and have us call to collect information.

Questionnaire

- Detailed trip purpose (confirmation of previous response, or expand to six to eight categories);
- Travel party size (confirmation of previous response, or expand to number of adults and number of children, and/or number of household members and nonmembers);
- Nights away from home;
- Luggage-checked/carry-on;
- Itinerary (one-way trip, round-trip based at surveyed airport, round-trip based at destination airport, more complicated itinerary);
- Seating class (for flights with available first class);
- Fare paid;
- Fare reimbursement;
- Advance planning time for trip;
- Origin location (cross streets, city, state, zip);
- Origin place type;

- Airport access mode;
- Time arrived at airport for flight (may be in initial interview for Protocol #1 to improve response quality);
- Destination location (cross streets, city, state, zip);
- Destination place type;
- Airport egress mode;
- Vehicle availability for specific trip;
- Rental car usage on trip;
- Satisfaction level for trip;
- Frequency of travel between origin and destination metropolitan areas by purpose (three purposes) by auto, rail, air (fill-in table);
- Airline/Amtrak frequent traveler club membership and membership level;
- High-speed rail description;
- Preferred origin and destination stations for HSR and conventional rail;
- Station access and egress modes for HSR and conventional rail;
- Four stated-preference questions – Choice of mode (air, HSR, conventional rail, auto) with level-of-service attributes (main mode fare/cost, main mode time, service frequency for non-auto modes, bundled en-route amenities) – See discussion below;
- Concept assessment rating for high-speed rail;
- Benefits of high-speed rail concept (open-ended);
- Disadvantages of high-speed rail concept (open-ended);
- Importance ratings for potential individual HSR station and en-route amenities;
- Expected change in trip frequency with a specific HSR scenario available; and
- Demographics:
  - Gender,
  - Age category,
  - Household size – Adults and children,
  - Vehicles available to household,
  - Total number of airline and Amtrak trips in past six months,
  - Home zip code,
  - Educational attainment,

- Employment status, and
- Income.

3.3 RAIL PASSENGER INTERCEPT SURVEY

Objective

Collect RP/SP mode choice model estimation data.

Sampling

The rail passenger surveys would be similar to the air passenger surveys, except we propose to conduct the intercept surveys onboard Amtrak trains. If we are allowed to ride the trains, fieldworkers will ride pre-assigned route segments where they will survey passengers. These segments will be designed to capture travelers that are going between the different metropolitan regions to maximize the usefulness of the sample for intercity modeling.

The Amtrak services of the most interest to us are the:

- Pacific Surfliner (southern segment), providing frequent service between the San Diego region and the Los Angeles region;
- San Joaquin, providing service between the San Joaquin Valley between Stockton and Bakersfield; and between the San Joaquin Valley and the Bay Area.
- Capitol Corridor (eastern segment), providing service between Sacramento and the Bay Area.
- Altamont Commuter Express (northern segment), providing service between the Central Valley and the Bay Area.
- Metrolink (Orange County Line), providing service between Northern San Diego County and the SCAG region.

Several other Amtrak services in California provide limited service between points of relevance, including:

- Pacific Surfliner (northern segment);
- Coast Starlight;
- California Zephyr;
- Southwest Chief; and
- Sunset Limited/Texas Eagle/Heartland Flyer.

But, we propose to concentrate on the three most relevant services.

Table 3.3 shows the number of train trips from which the sample will be drawn. Surveying passengers between the stations indicated in the table will enable us to

collect data on relevant intercity trips of variable length, including trips that utilize the Amtrak bus connections.

As for the air passenger surveys, the sample of trains will be drawn, and then adjusted to ensure that fieldworkers can be used efficiently. A full cross-section of Monday through Thursday times of day will be maintained.

Table 3.3 Train Trips for Sample

Route	Northern Station	Southern Station	Intermediate Stations	Weekday Trains	Weekend Trains
Pacific Surfliner	Los Angeles	San Diego	9	22 (11 per dir.)	24 (12 per dir.)
San Joaquin	Sacramento	Bakersfield	10	4 (2 per dir.)	4 (2 per dir.)
	Oakland	Bakersfield	13	8 (4 per dir.)	8 (4 per dir.)
Altamont Commuter Express	Stockton	San Jose	6	6 (3 per dir.)	n/a
Metrolink – Orange County Line	Anaheim	Oceanside	7	12 (6 per dir.)	n/a
Capitol Corridor	Sacramento	Richmond	3	24 (12 per dir.)	18 (9 per dir.)

Survey Method

We have the same general design decision for the rail surveys as for the air passenger surveys – whether we want to include an intermediate mailing step in the survey or whether we want to allow respondents to complete the surveys onboard trains if they choose. The determination of the rail passenger approach will be made once the decision for the airline passenger survey is finalized following the initial pretest.

The two potential rail survey protocols mirror those of the air passenger survey and are presented in Table 3.4.

Table 3.4 Alternative Survey Protocols

Survey Steps	Protocol #1: Mail-Out/Call-Back	Protocol #2: On-site
Arrival	Teams of two to four interviewers will board the sampled trains at one of the stations in the table above.	
Screening	Interviewers will approach rail passengers and determine whether they are traveling between stations that would qualify their trips as intercity trips.	
Recruitment	Eligible passengers will be asked a small number of classification questions.	
Collection	The interviewers will collect these data by personal interview when possible, but they will also have self-administered forms to handout to potential participants who would prefer to do the survey themselves or who do not have time to complete the interview prior to the pre-boarding call. The interviewers will try to collect the completed self-administered forms, but the forms will include a business-reply mail option for those that are not collected at the airport.	The respondent will then be asked to take a printed survey from the interviewer. Respondents will have the choices of complete the survey while they ride on the train and return it to one of the surveyors; mail the survey back to us; or to allow us to call the respondent to collect their responses at a day and time of their choice. Interviewers will collect the necessary contact information from willing participants.
Contact Information	At the end of the interview and self-completion questionnaire, the respondents will be asked for their cooperation in completing a survey that will be mailed to them. They will be asked for mail and telephone contact information, and a good time to contact them by phone.	Interviewers will collect the necessary contact information from willing participants.
Completion	When the flight begins the pre-boarding and boarding process, interviewers will stop soliciting new people, and will simply collect completed self-administered forms.	
Passenger Counts	Interviewers will count the number of passengers onboard the trains between each station.	
Mail-out	Respondents will be mailed a customized survey to complete.	Respondents that have not returned a questionnaire in person or by mail will be contacted by phone at the arranged times to provide the questionnaire information.
Call-back	Respondents will be contacted by phone at the arranged times to provide the questionnaire information. Respondents who did not receive a questionnaire or have lost it will be re-sent a copy of it, and will be re-contacted by phone.	

The data quality/cost tradeoff for the rail survey protocols is similar to that of the air passenger survey. However, because many rail respondents would have a substantial amount of time to complete the survey onboard the trains and because the fieldwork shifts on each train will be long compared to the airline flights, it is more likely that the second protocol will be used for the rail survey than for the air survey.

An alternative approach for the Capitol Corridor service (and our preferred approach if the mail-out/call-back protocol is adopted for the air and other rail surveys) is to take advantage of a passenger database that was developed by our project team member, CC&G, in a recent survey effort. In January 2005, CC&G surveyed passengers and asked permission to re-contact them by phone for later surveys. We would use the January trips as the reference trip for the SP exercises. The client for the previous survey effort is amenable in principle to sharing the database with our project.

If interviews are held on the Capitol Corridor trains, interviewers will need to simply distribute self-completion or self-completion/mailback questionnaires to passengers seated in the Capitol Corridor quiet cars without performing any oral interviews. Interviews and survey instruments for the rail survey will be provided in English and possibly Spanish.

Sample Size

As noted above, to develop the stated-preference exercises, we would like to obtain about 100 responses for the key travel market segments for the two most commonly used modes (air, and auto) and about 75 responses for each segment from the rail survey. As with the air surveys, these sample sizes are based on rules-of-thumb and experience with stated-preference surveys. Stated-preference models may be estimated with fewer samples, so the sample size estimates should be viewed as targets rather than as strict quotas.

Assuming that the smallest of the market segments analyzed will make up at least 15 percent of the surveyed trips, to get the 75 completed surveys for each segment, we will need about 450 completed total rail passenger surveys.

For estimating purposes on the first protocol, we are assuming that a 50 percent recruitment "overage" will be required. That is, if 250 to 400 completed SP interviews are required, we would need to recruit approximately 375 to 600 respondents who provide contact information and agree to participate in the follow up survey.

Crews of one or two surveyors will be used to conduct the on-board rail survey. The ridership estimates for specific trains will be used to determine whether one or two interviewers are needed. As with the airport survey, the number of recruited surveys that will be conducted will vary significantly by line. However, on average we estimate that we will be able to conduct between 25 to 75 recruit surveys per train run (average of 50 per train run). Assuming that on-board surveying will be conducted on the Pacific Surfliner and the San Joaquins,

we anticipate scheduling interviewing on a total of about eight to 12 one-way train runs in order to meet or exceed our recruitment goals. We do not plan on conducting on-board surveys on the Capitol Corridor since we expect to be able to use a Capitol Corridor customer list (which includes phone numbers of riders) for recruitment purposes.

On the second protocol, here again a pretest may be needed to determine the share of respondents who will be willing to do the full SP survey while they are riding on the train compared to those who we will recruit and re-contact (as in mail-out/call-back protocol). As with the airports, there will be some efficiency realized by not having to re-contact some of these respondents. Because the riders are in a comfortable setting and tend to be on-board for a long period of time, it may turn out that the number of surveys (recruit surveys and full surveys) collected per shift may not drop significantly. It is likely that the on-site protocol may better suited to the on-board rail surveys than it might be for the airport surveys.

Survey Content

The proposed data elements for the rail passenger survey are essentially the same as for the air passenger surveys, with some minor exceptions such as the deletion of questions about seating class. The projected data elements are shown below.

Initial Interview

- Origin station and destination station (determine eligibility based on need for trips between different California metro areas);
- Frequency of train travel between origin and destination station;
- Trip purpose (three categories);
- Total number of party members; and
- Willingness to complete a survey and have us call to collect information.

Questionnaire

- Detailed trip purpose (confirmation of previous response, or expand to six to eight categories);
- Travel party size (confirmation of previous response, or expand to number of adults and number of children, and/or number of household members and nonmembers);
- Nights away from home;
- Luggage;
- Itinerary (one-way trip, round-trip based at Northern station, round-trip based at southern station, more complicated itinerary);

- Fare paid;
- Fare reimbursement;
- Advance planning time for trip;
- Origin location (cross streets, city, state, zip);
- Origin place type;
- Rail station access mode;
- Time arrived at station for train (may be in initial interview for Protocol 1 to improve response quality);
- Destination location (cross streets, city, state, zip);
- Destination place type;
- Rail station egress mode;
- Vehicle availability for specific trip;
- Rental car usage on trip;
- Satisfaction level for trip;
- Frequency of travel between origin and destination metropolitan areas by purpose (three purposes) by auto, rail, air (fill-in table);
- Airline/Amtrak frequent traveler club membership and membership level;
- High-speed rail description;
- Preferred origin and destination stations for HSR and conventional rail;
- Station access and egress modes for HSR and conventional rail;
- Four stated-preference question – Choice of mode (air, HSR, conventional rail, auto) with level-of-service attributes (main mode fare/cost, main mode time, service frequency for non-auto modes, bundled en-route amenities) – see discussion below;
- High-speed rail concept assessment rating;
- Benefits of high-speed rail concept (open-ended);
- Disadvantages of high-speed rail concept (open-ended);
- Importance ratings for potential individual HSR station and en-route amenities;
- Expected change in trip frequency with a specific HSR scenario available; and
- Demographics:
  - Gender,
  - Age category,

- Household size – Adults and children,
- Vehicles available to household,
- Total number of airline and Amtrak trips in past six months,
- Home zip code,
- Educational attainment,
- Employment status, and
- Income.

3.4 HOUSEHOLD AUTO TRAVELER SURVEY

Objective

Collect RP/SP mode choice model estimation data. Collect a limited amount of intercity trip generation and distribution data to help validate models developed from the existing data sources (California Statewide Travel Survey).

Sampling

To capture the mode choice decisions of intercity travelers who have chosen to use autos, we will rely on household surveys of residents of the study area. We will use a stratified sampling approach. We will divide the State into the relevant regions, and set a targeted number of completes for households within each region.

The survey target regions will include:

- San Diego;
- Los Angeles;
- Bakersfield;
- Tulare County/Visalia;
- Fresno;
- Merced;
- Bay Area;
- Modesto/Stockton; and
- Sacramento.

Survey Method

Like the intercept surveys, the household survey will entail performing an initial survey and then a follow-up survey that is keyed to trip information provided in the first survey. Unlike with the intercept surveys where the respondent is

engaging in a relevant trip when we begin our survey, with the household surveys we first need to identify a candidate intercity auto trip.

There are several methodological options for performing these surveys, including:

- Telephone-mail-telephone surveys where respondents are initially contacted through random-digit-dialing;
- Mail panel surveys; and
- Internet panel surveys.

Our initial recommendation is to perform these surveys as telephone-mail-telephone surveys. This approach is the most comparable to the intercept approaches, and of the three options, allows for the best controls on target sample sizes. If necessary, we can also assess the costs, schedules, benefits, and issues of the alternative methodologies, but this plan assumes that the survey will be performed as a telephone-mail-telephone survey.

Using random-digit dialing methods, we will call households in each of the nine target regions. We will determine whether the household members have made any auto trips to the other regions in the past six months.[2] If the respondent reports one or more intercity auto trips, then one of their most recent trips will be selected as the subject trip for the second survey.

If the respondent has not made any relevant intercity auto trips, then the initial telephone survey will continue with interviewers asking about the frequency of trips to other regions by air and rail. These respondents will not be asked to participate in the follow-up survey.

For those that qualify for the second survey and agree to participate, we will arrange a date and time to re-contact them and then mail them a survey, and finally call them at the arranged time to collect their mail survey responses. Respondents that have not received a mail survey will be mailed a second one and will be re-contacted. Interviews and survey instruments will be provided in English and possibly Spanish.

Sample Size

As noted above, to develop the stated-preference exercises, we would like to obtain at least about 100 responses for each of the three intercity travel purposes (business/commuting, vacation/recreation, other) for the air and auto modes. For the auto surveys, we would also like to ensure that we obtain enough responses from the different geographical regions if possible.

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[2] The ideal travel recall period would be one year to account for seasonal differences in travel, but the previous high-speed rail data collection effort showed that a six-month period results in more accurate data.

If we assume that the smallest market segment that will be modeled makes up 15 percent of the auto trips, then we would need 600 completed household auto SP/RP surveys. These surveys would be distributed among the geographic areas, so that we would obtain about 67 completed surveys from each of the nine areas.

Respondents will be recruited using a random digit dial (RDD) sample targeting specific geographic areas in Northern and Southern California. As a lead-in on the recruit questionnaire, it may be appropriate for interviewers to identify themselves as working on a study concerning the proposed High-Speed Rail for the Metropolitan Transportation Commission (and/or the High-Speed Rail Authority).

We have built in a 20 percent "overage" for this telephone survey. That is, we would anticipate recruiting at least 600 respondents to be able to achieve 500 callback interviews. We feel that this 20 percent overage will be sufficient to achieve the targeted number of callback interviews, assuming that 1) the length of the survey instruments don't change significantly from what is outlined in this document (approximately five to seven minutes for recruit survey and less than 15 minutes for call back survey); 2) we are able to identify the sponsoring entity – the Metropolitan Transportation Authority and the High-Speed Rail Authority; and 3) we are not asked to achieve any low-incidence target quotas beyond what is outlined in this plan.

Our recruitment acceptance ratio is estimated by determining how many interviewer hours it will take to recruit a single respondent. We are using an incidence figure of 30 to 40 percent in figuring our time per recruit estimate. Other factors include: length of the survey(s), type of sample (RDD in this case), and demographic profile of target respondents, screening criteria, and interest level of survey to potential respondents. Based on the projected incidence level and these other factors we have allocated approximately 1.5 to 2.0 hours per recruit across the different geographic markets we are surveying.

Survey Content

The initial telephone survey will include initial screening questions and questions to determine whether the respondent household has eligible auto trips. If the household has eligible trips then the respondent is asked to complete the mail survey. If the respondent household does not have eligible auto trips, the respondent is asked in the telephone survey about trips by other modes. The non-auto trip respondents will not be asked to participate in the mail survey.

Telephone Survey

- Confirmation of geographic target area of respondent's home;
- Number of auto trips made by household to target area 1 in past six months;
- Number of auto trips made by household to target area 2 in past six months;

- Number of auto trips made by household to target area 3 in past six months;
- Number of auto trips made by household to target area 4 in past six months;
- Number of auto trips made by household to target area 5 in past six months;
- Number of auto trips made by household to target area 6 in past six months;
- Number of auto trips made by household to target area 7 in past six months;
- Number of auto trips made by household to target area 8 in past six months;
- If one or more auto trips are reported:
  - Date of most recent trip to one selected area,
  - Purpose of the trip (three categories),
  - Total number of party members, and
  - Willingness to complete a survey and have us call to collect information;
- If no auto trips are reported:
  - Any air trips to any of the eight regions over past six months,
  - Number of air trips made to each target area over past six months,
  - Any rail trips to any of the eight regions over past six months, and
  - Number of rail trips made to each target area over past six months.

The mail portion of the household survey will consist of essentially the same questions as the air and rail intercept surveys, except for the deletion of the access/egress trip information and the inclusion of questions that help explain the choice of the auto mode.

Questionnaire

- Detailed trip purpose (confirmation of previous response, or expand to six to eight categories);
- Travel party size (number of Adults and number of Children, and/or number of household members and nonmembers);
- Nights away from home;
- Luggage;
- Number of stops/destinations on the trip;
- Travel costs;
- Travel cost reimbursement;
- Advance planning time for trip;
- Origin location (cross streets, city, state, zip);
- Origin place type;

- Destination location (cross streets, city, state, zip);
- Destination place type;
- Reasons for selection of auto for the trip, rather than a public mode;
- Airline/Amtrak frequent traveler club membership and membership level;
- Satisfaction level for trip;
- Frequency of travel between origin and destination metropolitan areas by purpose (three purposes) by auto, rail, air (fill-in table);
- High-speed rail description;
- Preferred origin and destination stations for HSR and conventional rail;
- Station access and egress modes for HSR and conventional rail;
- Four stated-preference questions – Choice of mode (air, HSR, conventional rail, auto) with level-of-service attributes (main mode fare/cost, main mode time, service frequency for non-auto modes, bundled en-route amenities) – see discussion below;
- High-speed rail concept assessment rating;
- Benefits of high-speed rail concept (open-ended);
- Disadvantages of high-speed rail concept (open-ended);
- Importance ratings for potential individual HSR station and en-route amenities;
- Expected change in trip frequency with a specific HSR scenario available;
- Frequency of travel to other destination metropolitan areas by purpose (three purposes) by auto, rail, air (fill-in table); and
- Demographics:
  - Gender,
  - Age category,
  - Household size – Adults and children,
  - Vehicles available to household,
  - Airline/Amtrak frequent traveler club membership,
  - Total number of airline and Amtrak trips in past six months,
  - Home zip code,
  - Educational attainment,
  - Employment status, and
  - Income.

3.5 STATED-PREFERENCE EXERCISES

Figures 3.1 and 3.2 present a rough draft of the formatting of a mode choice SP question. The main idea is that the person is given lists of actual/possible airports/stations to choose from, and writes in their chosen departing and arriving airports/stations for each of three passenger modes – air, conventional rail, and high-speed rail – on a summary sheet. They are then asked to estimate the time and cost to get to/from each of these airports/stations and write those on the summary sheet as well.

The actual wording of the questions would be in a different place in the questionnaire, and the ordering of the questions is fairly flexible. The key for the SP is that the access/egress location, time and cost information all be consolidated in this single-sheet format so that it can be used in the mode choice tradeoffs. We can either ask the person to answer the question someplace else in the questionnaire and then copy the answers onto the summary sheet, or else instruct them to write their answer on the summary sheet the first time they encounter the question – whichever seems easiest.

Then, for each of four choice scenarios per person, we will supply preset values for journey time, frequency, and fare in the bottom three rows of the table, and ask the person to overlay the summary sheet on each of these four scenario sheets to make their choices. The introduction and instructions to the SP that describe the options and how to make the choice will be part of the main paper questionnaire.

Note that if we could also fit the lists of relevant airports/stations onto the summary sheet, then everything that would need to be OD-specific could be on the summary sheet and scenario sheets, and the main questionnaire could be the same across ODs. That may be too much information to fit onto the summary sheet, however, and might introduce too much "clutter" onto the sheet that would make the SP choice task more confusing.

Figure 3.1 Access and Egress Summary Sheet

TRAVEL BY AIR	TRAVEL BY CONVENTIONAL RAIL	TRAVEL BY HIGH-SPEED RAIL	TRAVEL BY CAR
Departing airport _____ Travel to the airport by __ Drive and park __ Get dropped off __ Taxi/shuttle __ Bus/train __ Rental car __ Other Time to get to the airport: ___ minutes Cost to get to the airport: $ ____	Departing station _____ Travel to the station by __ Drive and park __ Get dropped off __ Taxi/shuttle __ Bus/train __ Rental car __ Other Time to get to the station: ___ minutes Cost to get to the station: $ ____	Departing station _____ Travel to the station by __ Drive and park __ Get dropped off __ Taxi/shuttle __ Bus/train __ Rental car __ Other Time to get to the station: ___ minutes Cost to get to the station: $ ____	Travel in: __ Own vehicle __ Rental vehicle
Arriving airport _____ Go from the airport by __ Car parked there __ Get picked up __ Taxi/shuttle __ Bus/train __ Rental car __ Other Time to go from the airport: ___ minutes Cost to go from the airport: $ ___	Arriving station _____ Go from the station by __ Car parked there __ Get picked up __ Taxi/shuttle __ Bus/train __ Rental car __ Other Time to go from the airport: ___ minutes Cost to go from the airport: $ ___	Arriving station: _____ Go from the station by __ Car parked there __ Get picked up __ Taxi/shuttle __ Bus/train __ Rental car __ Other Time to go from the airport: ___ minutes Cost to go from the airport: $ ___	

Figure 3.2 Choice Situation Example

TRAVEL BY AIR	TRAVEL BY CONVENTIONAL RAIL	TRAVEL BY HIGH-SPEED RAIL	TRAVEL BY CAR
The travel time by air is **1 hour** (no transfer required)	The travel time in the train is **7 hours** (no transfer required)	The travel time in the train is **3 hours** (no transfer required)	The travel time by car is **6 hours 30 minutes**
There is a flight every **3 hours**	There is a train every **6 hours**	There is a train every **3 hours**	
The round-trip fare is **$330**	The round-trip fare is **$110**	The round-trip fare is **$210**	The round-trip fuel cost is **$120**

3.6 PRE-TEST

A pre-test of the airport intercept survey was conducted on May 19, 2005 at San Francisco Airport for the San Francisco to Los Angeles flights. A summary of the results of the pre-test, along with the questionnaires will be included in a separate technical memorandum for review by the peer review panel.

A pre-test of the household survey is also planned. This will be conducted after comments are received by the peer review panel and the results of the airport intercept pre-test are analyzed. A pre-test of the rail intercept survey is not planned, as it is very similar to the airport intercept survey and is expected to be easier to collect because it can be done on-board.

4.0 Performance Measures

This section describes evaluation measures that are suggested for incorporation into the statewide high-speed rail travel demand model. The suggested measures will allow for assessment of model reliability and validity, and will also provide ample data that can be used in subsequent planning and environmental work for the HSR project or for regional-level transportation planning activities. The measures have also been carefully selected so that they can be integrated with other non-model data to produce secondary measures such as cost-effectiveness, benefit-cost ratios, energy consumption, or equity.

4.1 DEVELOPING MEASURES

The first step in developing evaluation measures was to identify the major audiences, or potential users, for the evaluation measures. Each audience can be characterized by the level of technical background, interest in summary versus detailed information, time available to review the measures, and likely use for the measures (i.e., subsequent analysis, decision-making needs, information-purposes only, etc.). Four primary audiences were identified:

1. **Technical staff –** This audience is comprised of planners, engineers, economists, scientists and others with public sector agencies or private organizations who could be asked to review the technical merits of the model or project. This audience includes the Peer Review Committee, HSRA and MPO staff, and the consultant team for MTC's Regional Rail Study.
2. **Public sector decision-makers –** This audience is comprised of local, regional, state, and Federal elected officials and agency decision-makers who could be asked to approve or support some aspect of the HSR system.
3. **Private sector –** This audience is comprised of individuals or organizations that could be involved with funding, construction, operations, or other HSR implementation activities. This audience might include bond underwriters, contractors, freight rail operators, small package shippers, developers, concessionaires, and others.
4. **General public –** This audience includes residents of California and other states who would be potential users or beneficiaries of an HSR system, or who might be asked to approve public financing of the HSR system.

It is expected that these four audiences would have varying information needs, but that these needs could be grouped into four broad categories of evaluation measures that could be derived from the travel demand model:

- Usage measures such as trips and system boardings for each intercity travel mode;

- Travel time and congestion measures for travel across the State, within individual metropolitan areas, and at individual HSR stations;
- Financial measures such as direct and indirect revenue generation potential; and
- Externality measures for critical air quality planning issues throughout the State.

A fifth category was added to reflect and report the input data that tends to be the key drivers of the other measures. Although this category is not truly evaluation measures, per se, it nonetheless contains very important information for use in assessing model accuracy and undertaking subsequent planning activities.

Identification of potentially appropriate measures for each category was guided by similar efforts that have been conducted in California and elsewhere. Model evaluation reports and environmental documents prepared by the High-Speed Rail Authority provided key input on the intercity aspect of the measures. The Regional Transportation Plan (RTP) for each metropolitan planning organization (MPO) in the potential HSR service area was reviewed for guidance on regional and urban planning desires. The Federal Transit Administration's New Starts guidance and SUMMIT software integrates some commonly used measures for evaluating major fixed guideway investments. Finally, Caltrans' recently-released Transportation System Performance Measures Report provided an indication of measures that might become more widely used in California in coming years. A summary of the performance and evaluation measures from each of these sources is provided in Appendix A.

4.2 RECOMMENDED MEASURES

This summary information from similar efforts was combined with the consultant team's experience with model development and performance-based planning in other locations to develop a list of suggested evaluation measures. Some of these performance measures from relevant California Plans are provided in the Appendix. The evaluation measures, shown in Table 4.1, were organized by category and then matched with the audience that would likely be most interested in the measure. Six of the suggested measures are likely to be of interest to the general public, 19 for the private sector, 17 for decision-makers, and 43 for technical staff. Some of the measures, highlighted in gray in Table 4.1, are intended for regional rather than intercity transportation planning activities.

The purpose of developing performance measures at this early stage is two-fold: first, performance measures will be defined prior to any evaluations of Bay Area high-speed rail alignments to maintain analytic objectivity; second, pre-definition of alternatives helps the study team standardize model run outputs, thus, streamlining data processing.

Table 4.1 Recommended Evaluation Measures for Integration with Intercity/HSR Travel Demand Model

Recommended Evaluation Measures	Intended Audience			
	Technical Staff	Public Sector Decision-makers	Private Sector	General Public
Usage Measures				
Annual HSR ridership (total)	✓	✓	✓	✓
Annual HSR ridership (by purpose, access mode & egress mode)	✓	✓		
Daily HSR ridership (average weekday & weekend)	✓			
Annual HSR ridership at 25th, 50th, 75th & 90th percentile			✓	
Total station entries by station (annual, average weekday & weekend)	✓	✓	✓	✓
Station entries by station (annual by purpose & access mode)	✓	✓		
Station exits by station (annual by purpose & egress mode)	✓			
Station entries and exits by station for rapid transit and commuter rail systems (annual by purpose, access mode & egress mode)	✓			
Intercity trips by mode (annual total & by key market O-D interchanges [a])	✓	✓		
Intercity trips by mode & purpose (annual total & by key market O-D interchanges [a])	✓			
Annual total HSR ridership by source (diverted mode & induced)	✓		✓	
Induced HSR trips (by key market O-D interchanges [a])	✓		✓	
Daily urban trips by mode & purpose (total & by key Bay Area urban markets)	✓			
Work trips by mode for Bay Area jobs (annual total & by key job center)	✓	✓		
Work trips by mode and residential location for Bay Area jobs (annual total & by key job center)	✓			
Travel Time and Congestion Measures				
Total door-to-door travel time in key intercity corridors[b] by mode (peak & off-peak)	✓	✓		✓
Door-to-door travel time in key intercity corridors[b] by mode (peak & off-peak by time component)	✓			
Probability distribution of travel time differences between modes in key intercity corridors[b]			✓	
Door-to-door travel time in key urban corridors by mode (peak & off-peak by time component)	✓			

Table 4.1 Recommended Evaluation Measures for Integration with Intercity/HSR Travel Demand Model (continued)

Recommended Evaluation Measures	Intended Audience			
	Technical Staff	Public Sector Decision-makers	Private Sector	General Public
Auto vehicle miles traveled (VMT) by volume-to-capacity ratio	✓			
Annual hours of intercity auto travel in congested conditions	✓	✓		✓
Annual hours of urban auto travel in congested conditions (by county & metropolitan area)	✓	✓		
Annual airport delay	✓	✓		✓
HSR peak daily line loads by segment	✓		✓	
HSR peak boardings and alightings by station	✓		✓	
Number of jobs accessible within 60 minutes and 180 minutes travel time (by county & metropolitan area)	✓			
Population accessible within 60 minutes travel time (by county & metropolitan area)	✓			
Multimodal travel utility for intercity trips (annual total by county)	✓			
Multimodal travel utility for urban trips (average weekday & annual by metropolitan subregion)	✓			
Number of jobs accessible within 30 minutes and 60 minutes travel time by mode (by subarea)	✓	✓		
Population accessible within 60 minutes travel time (by key Bay Area job center)				
Financial Measures				
Annual HSR passenger fare revenue (total)	✓	✓	✓	✓
Annual HSR passenger fare revenue (by purpose & day of week)	✓		✓	
Annual HSR passenger fare revenue by source (diverted mode & induced)	✓		✓	
Annual HSR passenger fare revenue at 25th, 50th, 75th and 90th percentile			✓	
Annual parking at HSR stations (by purpose, station & cost level)	✓	✓	✓	
Annual transfers to local transit (by station)	✓	✓		
Externality Measures				
Ozone precursor emissions by county for auto travel	✓	✓		
PM-2.5 & PM-10 emissions by county for auto travel	✓	✓		

Table 4.1 Recommended Evaluation Measures for Integration with Intercity/HSR Travel Demand Model (continued)

Recommended Evaluation Measures	Intended Audience			
	Technical Staff	Public Sector Decision-makers	Private Sector	General Public
Key Input Data				
HSR and airline fares in key intercity corridors	✓	✓	✓	
Air travel times in key intercity corridors (current & future)	✓	✓	✓	
Auto operating costs	✓		✓	
Auto parking costs	✓		✓	
Population & employment (by county)	✓		✓	
Population & employment (by subregion and transit planning area)	✓			
Intercity trip generation rates	✓		✓	
Value of time by trip purpose, travel mode & portion of trip	✓			

[a] It is suggested that the following groupings be used for "key market O-D interchanges": SACOG region, MTC region, SCAG region, SANDAG region, Northern San Joaquin Valley (north of Fresno County), and Southern San Joaquin (Fresno County southward).

[b] The suggested cities that comprise the "key intercity corridors" are Sacramento, Modesto, Fresno, Los Angeles, San Diego, San Francisco, and San Jose. It is suggested that the center point of the central business district be used for calculating travel times.

Shaded cells indicated evaluation measures that are intended to primarily support Bay Area transportation planning activities.

The project team followed a number of general principles in recommending specific evaluation measures within the major categories of interest:

- Include measures that can be readily derived from the travel model, and that are reasonably related to factors that are considered in the modeling process;
- Report measures at different levels of detail and aggregation where appropriate to address different audiences;
- Focus on measures that are most relevant to intercity travel, but also include measures that address the interests of local jurisdictions that might be served by HSR stations;
- Include measures that are likely to be needed to support ongoing planning and environmental work for the HSR system and for regional-level transit planning activities in the Bay Area;
- Include measures that reflect the concept of risk assessment and sensitivity to input data;
- For transparency reasons, include reporting of the input data that are key performance drivers; and
- Rely to the greatest extent possible on measures that have been used on prior HSR studies or are relatively widely used by transportation planning agencies in California[3].

Table 4.2 presents an example of how performance measures might be presented to different audiences, and in this particular example, decision-makers and the interested public. For these groups, it will be important to summarize the key results in an easy-to-understand format, yet still convey meaningful information.

The working concept here is to present summary information for each alternative on one-page fact sheets. These fact sheets will summarize the pertinent information about the alternative, such as alignment and key service characteristics. A small map will be provided to display the alignment into the Bay Area and connection to the Central Valley. Key input and output data for the most relevant alternatives will also be displayed. In this example, base year data for 2000 and 2005 are provided, as are the 2030 baseline and 2030 project alternative.

[3] It should be noted that the MPO RTP sources provided limited guidance for this project since many of those measures tend to have a strong technical focus and are oriented towards roadway travel times and congestion levels. On the other hand, the TSPM and prior HSR efforts had a common theme of stressing the concepts of travel times and trips in key intercity travel markets; these concepts were carried into the recommended performance measures in Table 1.

Table 4.2 Example of Possible Evaluation Table for a Selected High-Speed Rail Alternative – For Decision-makers and General Public

Alternative Number and Description

	Year 2000	Year 2005	Year 2030 No-Project	Year 2030 Alternative	Notes:
Key Input data					
Population Indicator					
Employment Indicator					
HSR door-door travel times (LAUS-TBT)					
Non-commute door-door highway travel times (LAUS-TBT)					
Air door-door Travel Times (LAUS-TBT)					
HSR/Air Fares (LAX-SFO, LAUS-TBT)					
Output data					
Annual HSR ridership					
Highway time savings with HSR (minutes of time saved – LAUS-TBT)					
Intercity HSR Mode Share					
Commuter HSR Mode Shares					
….					

Simplified map and Service Characteristics of Bay Area Alignment and Stations for Selected Alternative

Service Characteristic:

Headways (minutes): Peak/Off-Peak __ /__

Other _____

HSR Travel Times:

Fresno – Oakland _____

Fresno – San Francisco _____

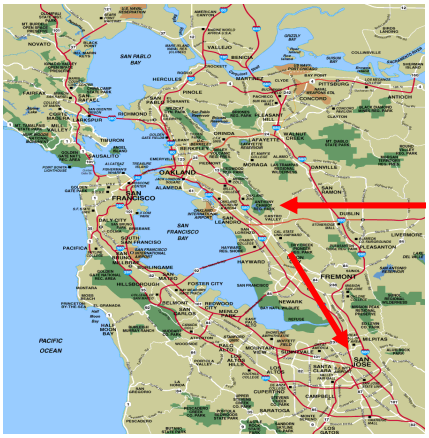
Fresno – San Jose _____

Other – Other _____

Other – Other _____

Notes: _____

_____



More detailed performance measure summaries would be developed for technical reviewers. Those summaries would certainly comprise multiple pages, and would be based on the measures described in Table 4.1.

4.3 REVIEW OF MEASURES

An important consideration will be to submit these prospective performance measures to public review. Until these measures have been reviewed and commented upon, performance evaluation criteria cannot be considered final.

Currently, there have been no decisions regarding creating public review forums for this particular study. However, it is very likely that the related Regional Rail Study will create those necessary public forums (through public meetings and a project web site) that can be used to gain critical public feedback on performance measures.

A. Performance Measure Summary from Relevant California Plans

High-Speed Rail Authority – Year 2000 Independent Ridership and Revenue Projections

- Annual ridership – total, by key O-D market segment, and by purpose;
- Annual revenue – total, by key O-D market segment, and by purpose;
- HSR ridership source (i.e., diverted mode);
- HSR revenue source (i.e., diverted mode);
- Percent of trips diverted by source;
- Travel mode market share with and without HSR – total and by key O-D market segment;
- Values of time by trip purpose, travel mode, and portion of trip (i.e., line haul vs. access/egress); and
- Boardings by station – annual (total and by local/connect) and average daily.

Caltrans – Transportation System Performance Measures State-of-the-System Prototype Report

Mobility/Reliability/Accessibility

- Travel time within key regional travel corridors;
- Total person (passenger) hours of delay;
- List modes available in key corridors and at key transportation centers;
- Percent of workers within "x" (15, 30, 45, 60) minutes of their jobs;
- Modal split (including choice ridership);
- Percent of jobs within a one-quarter/one-half mile of a transit station or corridor;
- Percent of population within one-quarter/half mile of transit station/stop or bus corridor;
- Percent on-time performance in key corridors; and
- Variability in travel time (state highways).

Productivity

- Percent utilization during peak period (highway);
- Passengers per vehicle revenue mile (transit);
- Passengers per vehicle revenue hour (transit);
- Passenger miles per train mile; and
- Percent trucks by axle.

System Preservation

- Pavement – smoothness and distressed miles;
- Bridges – structurally deficient or functionally obsolete;
- Roadside;
- Vehicle fleet age;
- Miles between service calls; and
- General aviation runway pavement condition.

Safety

- Fatal/injury collisions and fatalities/injuries – rates and totals.

Environmental Quality and Air Quality

- Days exceeding national/state standards by region/air basin and statewide.

Noise

- Number of residential units exposed to transportation generated noise exceeding standards.

Energy Consumption

- Fossil fuel use ratio to passenger miles traveled.

FTA New Starts Project Justification Criteria

- Multimodal travel utility (i.e., "travel time savings" or "logsums");
- Total capital costs;
- Annual operating costs;
- Low income households within one-half mile of boarding points;
- Employment within one-half mile of boarding points;
- Criteria pollutant and precursor emissions;

- Greenhouse gas emissions;
- Energy consumption;
- Operating cost per passenger mile; and
- Annual transit trips (linked).

San Diego Association of Governments 2003 Regional Transportation Plan (Mobility 2030)

- Average work trip travel time;
- Average daily travel time;
- average work trip travel speed by mode;
- Work/school trips within 30 minutes;
- Non-work trips within 15 minutes;
- Daily crashes and fatalities;
- Congested peak period travel conditions;
- Congested daily travel conditions;
- Out of pocket user costs;
- Total 30-year public and private travel costs;
- Homes within one-half mile of a transit stop;
- Jobs within one-quarter mile of a transit stop;
- Work trip mode split;
- Ozone precursor emissions;
- On-road fuel consumption (gallons);
- Daily vehicle miles traveled; and
- Daily transit passenger miles.

Southern California Association of Governments 2004 Regional Transportation Plan

- Average daily speed (across all modes);
- Average daily person-hours of delay;
- Percent PM peak period work trips within 45 minutes of home;
- Distribution of work trip travel times;
- Percent variation in travel time;
- Crash rates;

- Benefit-to-cost ratio;
- Percent capacity utilized during peak conditions;
- Total cost per capita to sustain current system performance;
- Maintenance cost per capita to preserve system at base year conditions;
- Emissions generated by travel;
- Expenditures by quintile and ethnicity; and
- Benefit versus burden by quintiles.

Kern Council of Governments 2004 Regional Transportation Plan

- Average travel time to major job centers by mode;
- Average travel time by mode and subregion in county;
- Emissions of ozone precursors;
- Average user cost per mile by mode and subregion in county;
- Roadway volume-to-capacity ratios and level of service; and
- Average trip delay time by mode.

Council of Fresno County Governments 2004 Regional Transportation Plan

- Average travel time and speed;
- Air quality emissions;
- Highway level of service; and
- Benefit-to-cost ratio.

Merced County Association of Governments 2004 Regional Transportation Plan

- Delay;
- Peak hour level of service;
- Travel time to destinations;
- Time to transportation system;
- Mode choice;
- Accident history;
- Pavement condition;
- Roadway utilization;

- Transit utilization;
- Potential impact to minorities, low-income;
- Access to employment centers;
- Time (goods); and
- Benefit-cost ratio.

Stanislaus County Council of Governments Draft 2004 Regional Transportation Plan

- Average travel speeds on highways and principal arterials;
- Total air quality emissions;
- Vehicle miles of travel per person and per vehicle trip; and
- Average travel speeds on highways and principal arterials.

San Joaquin Council of Governments 2004 Regional Transportation Plan

- Daily vehicle-miles traveled;
- Daily vehicle-hours of delay;
- Highway lane miles during peak-periods;
- Peak-hour freeway travel speed;
- Person trips by mode;
- Transit frequency and timeliness;
- Transit farebox recovery ratios;
- Number and distance of bus stops; and
- Return on investment.

Sacramento Area Council of Governments 2004 Interim Metropolitan Transportation Plan

- Vehicle trips per capita;
- Vehicle-miles traveled;
- Vehicle-hours traveled;
- Roadway level of service;
- Congestion index;
- Mode choice;

- Number of employment centers within 20 minutes drive time from each community;
- Number of employment centers within 45 minutes time from each community on public transit; and
- Emissions of ozone precursors, carbon dioxide and large particles.

Metropolitan Transportation Commission 2004 Regional Transportation Plan (Project Performance Evaluation Report)

- Roadway volume-to-capacity ratio;
- Transit ridership, capacity and utilization;
- Bus speeds and number of trains per day;
- Vehicle volumes on freeway interchange ramps;
- Transit vehicles and passengers per day at transit hubs;
- Number of airport passengers and air cargo;
- Historical crash rates;
- Emissions of ozone precursors; and
- Vehicle-miles traveled for autos and trucks.